



DECLARATION

In the matter of
U.S. Serial No. 10/816,125
in the name of Yasuaki YATAGAI,
Hitoshi MATSUMURA,
and Hiroaki SHICHI

I, the undersigned, Kazuteru SHIMURA, of Fujimoto Patent and Law Office, of Room 317, Sanno Grand Building, 14-2, Nagata-cho 2-chome, Chiyoda-ku, Tokyo, Japan, do solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Japanese languages and am competent to translate Japanese into English and vice versa.

2. That I have executed, with the best of my ability, a true and correct translation to the attached copy of the complete description, claims, drawings and abstract originally filed as Japanese Patent Application No. 2000-270363.

This 24th day of July, 2006

A handwritten signature in black ink, appearing to read "Kazuteru Shimura", written over a horizontal line.

Kazuteru SHIMURA



(Translation)

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

| | |
|---|---------------------------------------|
| Date of Application: | September 6, 2000 |
| Application Number: | Patent Application No. 2000-270363 |
| The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is: | JP2000-270363 |
| Applicant(s): | SUZUKI MOTOR CORPORATION |

December 19, 2005

Commissioner,
Japan Patent Office Makoto NAKAJIMA (Seal)

Certificate No. P 2005-3104727



1
Japanese Patent Application No. 2000-270363

[Name of Document] Petition for Patent Application

[Reference Number] S990819

[Filing Date] September 6, 2000

[Address] Commissioner, Patent Office

[IPC] F01M 11/00

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2
Japanese Patent Application No. 2000-270363

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| [Deposit Ledger No.] | 077828 | |
| [Amount] | ¥21,000 | |
| [List of Submitted Things] | | |
| [Name of Thing] | Specification | 1 |
| [Name of Thing] | Drawing(s) | 1 |
| [Name of Thing] | Abstract | 1 |
| [General Power of Attorney No.] | 9907804 | |



[NAME OF DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION]

SNOWMOBILE FOUR-CYCLE ENGINE ARRANGEMENT

[SCOPE OF CLAIM FOR PATENT]

5 [CLAIM 1] A snowmobile four-cycle engine arrangement,
characterized in that a snowmobile four-cycle engine is
arranged in an engine compartment formed in the front body
of a snowmobile with its crankshaft laid substantially
parallel to the body width and having a cylinder portion
10 inclined forwards with respect to the vehicle's direction
of travel;

the engine employs a dry sump type for oil supplying
system in the engine; and

15 an oil tank is provided in the engine compartment,
separately from the engine.

[CLAIM 2] The snowmobile four-cycle engine arrangement
according to Claim 1, wherein the oil tank is arranged in
front of the engine and on the top of a front suspension housing
which is projected upwards from the bottom of the engine
20 compartment.

[CLAIM 3] The snowmobile four-cycle engine arrangement
according to Claim 1 or 2, wherein the oil tank is arranged
in the rear of the engine and on the upper face of a track
housing which is projected upwards from the bottom of the
25 engine compartment.

[CLAIM 4] The snowmobile four-cycle engine arrangement according to any one of Claims 1 to 3, wherein the engine compartment includes: an opening port disposed in the bottom thereof at a position opposing the bottom of the oil pan of the engine for creating communication between the inside and the outside; and a lid element that can open and close the opening port.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

10 [Technical Field of the Invention]

The present invention relates to an engine arrangement, and in particular relates to an arrangement of a four-cycle engine for a snowmobile.

[0002]

15 [Prior Art]

Conventionally, small snow vehicles such as snowmobiles have mainly used two-cycle engines. A two-cycle engine is characterized by a relatively simple engine configuration having the advantages of being lightweight and compact and still providing high power. However, two-cycle engines have drawbacks, when compared with four-cycle engines, of emitting a greater amount of exhaust and louder noise with greater vibrations.

[0003]

25 The recent worldwide trend demands a silent, clean and

environment-conscious engine. Snow vehicle engines are no exception and clean and silent engines have been desired. To deal with this, development of engines for snowmobile into a four-cycle configuration has been studied.

5 [0004]

A typical conventional snowmobile has a body frame in a monocoque frame configuration, and an engine is mounted in a space formed between a track housing and a front suspension housing in the front frame (engine mounting frame). For a
10 two-cycle engine, the engine is mounted upright in the engine compartment.

[0005]

[Problems to be Solved by the Invention]

However, if a four-cycle engine is attempted to be put
15 into used for a snowmobile in the same manner as above, the upright mounting has been difficult because a four-cycle engine has a greater full height compared to a two cycle engine due to its bulky cylinder head and the necessity of an oil pan. Further, since a four-cycle engine needs additional
20 parts unique to it such as an alternator, supercharger, intercooler, oil filter and the like, it has been very difficult to lay out all these parts in a limited engine compartment space.

[0006]

25 To deal with the above, there has been a layout proposal

as shown in FIG. 7 in that an engine 202 to be mounted on a snowmobile 201 is set inclined forwards in an engine compartment 206 so as to reduce the full height of engine 202 while the aforementioned components are laid out in the space created by the inclined arrangement of the engine 202.

[0007]

For a four-cycle engine, oil pan 238, needs to be positioned at the engine bottom. If the engine is of a wet sump type, a large oil pan 238 is needed, which will cause difficulty of interference with the steering shaft 224, as shown in FIG. 7.

Further, for a snowmobile, the underside of the engine compartment serves as a sled sliding over snow, hence needs to be closed, which makes maintenance work such as changing oil difficult.

[0008]

The present invention has been devised in view of the above conventional difficulties, it is therefore an object of the present invention to provide a snowmobile four-cycle engine arrangement with which space saving in the engine compartment is achieved and the performance of maintenance is improved.

[0009]

[Means for Solving the Problems]

The present invention relates to a snowmobile four-cycle

engine arrangement, and is characterized in that a snowmobile four-cycle engine is arranged in an engine compartment formed in the front body of a snowmobile with its crankshaft laid substantially parallel to the body width and having a cylinder portion inclined forwards with respect to the vehicle's direction of travel; the engine employs a dry sump type for oil supplying system in the engine; and an oil tank is provided in the engine compartment, separately from the engine.

[0010]

Further, it is preferred that the oil tank is arranged in front of the engine and on the top of a front suspension housing which is projected upwards from the bottom of the engine compartment.

It is also preferred that the oil tank is arranged in the rear of the engine and on the upper face of a track housing which is projected upwards from the bottom of the engine compartment.

Moreover, it is preferred the engine compartment includes: an opening port disposed in the bottom thereof at a position opposing the bottom of the oil pan of the engine for creating communication between the inside and the outside; and a lid element that can open and close the opening port.

[0011]

According to the present invention, since the engine employs a dry sump type for oil supplying system in the engine,

it is possible to make the engine body low in height. Since the oil tank is provided in the engine compartment, separately from the engine, it is possible to make efficient use of the space inside the engine compartment as well as to provide a space-saving engine arrangement.

[0012]

Since the oil tank is arranged in front of the engine, on the upper surface of the front suspension housing, it is possible to attain space saving. Further, this arrangement allows the oil tank to receive little thermal influence from the engine and makes it possible to cool the engine oil effectively from the air flow during travel.

[0013]

Further, since the oil tank is arranged on the top face of the track housing in the rear of the engine, it is possible to achieve space saving as well as to dispose it apart from the heat source of the engine. Further, with a cooling effect by the snow powder stirred up during travel, the engine oil can be cooled efficiently.

[0014]

Since the engine compartment has an opening port disposed in the bottom thereof for creating communication between the inside and the outside and a lid element that can open and close the opening port, it is possible to make an access to the engine from the underside of the engine compartment when

maintenance such as changing oil is needed, hence improve the workability.

[0015]

[Embodiment of the Invention]

5 The embodiment of the present invention will hereinafter be described in detail with reference to the drawings.

FIG. 1 is a partially sectional side view showing an overall configuration of a snowmobile employing a snowmobile four-cycle engine arrangement in accordance with the
10 embodiment of the present invention.

In the snowmobile four-cycle engine arrangement according to this embodiment, as shown in FIG. 1, a four-cycle engine 2 having a cylinder head 3 at the top thereof is arranged in an engine compartment 6 enclosed by a front cover 4 on
15 the front body side of a snowmobile 1 and is inclined forwards with respect to the vehicle's direction of travel with its crankshaft (not shown) laid substantially parallel to the body width and an intake path 5 is arranged on the top the inclined engine 2 body.

20 The engine 1 employs a dry sump oil supplying system therein.

[0016]

Now, the configuration of snowmobile 1 will be explained in detail.

25 Snowmobile 1 has a body frame 10 extending front to rear

as shown in FIGS. 1 and 2 with a pair of steerable, ski-type runners 13 arranged on the left and right under the front frame 11, so as to be turned to the left and right. Arranged under the rear frame 12, is a tractive crawler 16 that circulates track belt 15. This crawler 16 comprises a drive wheel 17 arranged at the front end of rear frame 12, an idle wheel 18 arranged at the rear end and a multiple number of middle wheels 19, a suspension mechanism 20 and the track belt 15 wound around these wheels and driven circulatively.

10 [0017]

Body frame 10 has a monocoque frame configuration. The front frame (engine mount frame) 11 on which engine 2 is mounted is constructed such that the part in front of a main part 11a is projectively formed upward forming a front suspension housing 11b for accommodating the upper part of front suspension 13a for supporting steerable ski-type runners 13. The part in the rear of the main part 11a is constructed such that a track housing 11c for accommodating the upper part of drive wheel 17 of crawler 16 is raised upwards and rearwards and is continuously and integrally formed with rear frame 12.

20 [0018]

The rear frame 12 is extended to the rear with respect to the vehicle's front-to-rear direction and also functions as the cover for accommodating the whole crawler 16 under

25

it.

A saddle type seat 22 is arranged on the top of rear frame 12 with steps 23 disposed with respect to body width below on the vehicle's sides of seat 22.

5 A steering shaft 24 is provided extending upward substantially in the center of the body between the seat 22 and front cover 4 while handlebars 26 extending horizontal to the left and right and slightly inclined rearwards are attached at the top of the steering shaft 24.

10 Disposed upright in front of handlebars 26 is a windshield 28, from the base of which front cover 4 is formed in a substantially streamline shape, or in a substantially inverted hull-bottom shape gradually lowering to the front.

15 Steerable ski-like runners 13 are adapted to be steered via steering shaft 24 by the handlebars 26.

[0019]

Next, the configuration of engine 2 will be described in detail.

20 As shown in FIG. 1, the engine 2 is a four-cycle engine and is arranged at the approximate center of engine compartment 6 inside front cover 4 with its crankshaft (not shown) laid substantially parallel to the body width and its cylinder head 3 inclined at a large angle forwards in the vehicle's direction of travel.

25 An intake path 5 including a carburetor, a throttle body

etc., is arranged on the upper side of the engine 2 body. An alternator 31 is arranged at the rear of it. An air cleaner 32 is arranged in the further rear.

[0020]

5 A flywheel (not shown) is disposed at one end (on the left side with respect to the vehicle's direction of travel) of the crankshaft and a V-belt type stepless transmission (not shown) incorporating a centrifugal clutch device is coupled on the outer side of this flywheel. This stepless
10 transmission is configured so as to transmit drive power to track belt 15 via gears etc., on the receiving side. A brake(not shown) is fitted at the other end of the receiving shaft of the stepless transmission.

15 Arranged at the other end of the crankshaft (on the right side with respect to the vehicle's direction of travel) is a pulley 34 functioning as a transmission for driving auxiliary equipment so as to drive alternator 31 and a water pump 35 provided on the pulley 34 side.

[0021]

20 A starter motor(not shown) is arranged in proximity to the flywheel on the top of the engine 2 body and under intake path 5 such as carburetor, throttle body etc. Disposed on the top of the engine 2 body is an intake manifold 37 which branches the intake path 5 from carburetor 36 into the intake
25 ports of the individual cylinders. The intake system of

carburetor 36 and air cleaner 32 from intake manifold 37 is coupled and arranged above the top position of cylinder head 3 and extended to the rear.

[0022]

5 The aforementioned intake system is located inside front cover 4 near the base of windshield 28 where the cover becomes higher. The top part of cylinder head 3 is accommodated, without interference with other components, in the front inner side of front cover 4 where it gradually lowers toward the
10 front.

 As the exhaust system, an exhaust manifold (not shown) is extended from a cylinder case 39, to the front of engine 2 and is connected to a supercharger 7. An exhaust path is created rearwards along the engine 2 body from this
15 supercharger 7 located at the engine 2 front. That is, supercharger 7 is connected by way of the exhaust path to a muffler (not shown) arranged on one side in the rear of the engine.

[0023]

20 As shown in FIG. 1, the engine 2 is inclined forwards in engine compartment 6 and mounted on, and along, front frame 11 with an oil pan 38 arranged adjacent to inclined track housing 11c and cylinder case 39 arranged adjacent to front suspension housing 11b.

25 [0024]

An oil tank 40 is arranged in front of the engine 2 on the top of front suspension housing 11b, separately from the engine 2.

5 The engine oil distributed to parts of the engine returns into oil pan 38 and is fed to the oil tank 40 via an oil strainer 41 and is re-supplied appropriately to the parts of the engine.

[0025]

10 In main part 11a constituting part of engine compartment bottom 6a, an opening port 50 for maintenance which establishes communication between engine compartment 6 and the external space and a lid element 51 for opening and closing the opening port 50 are provided at a position opposing the bottom of oil pan 38 of the engine 2.

15 This opening port 50 is approximately rectangular-shaped and has a size which allows for maintenance of oil pan 38 from the underside of engine compartment 6.

20 The one side of lid element 51 is engaged at one side of opening port 50 with a connecting means 52 such as a hinge etc., so that the lid element will be able to pivotally open. A lock mechanism 53 is provided on the other side of lid element 51 so that lid element 51 can be positively fixed to engine compartment bottom 6a when opening port 50 is closed.

[0026]

25 According to this embodiment thus configured, since engine 2 is configured of a dry sump type and arranged inclined

forwards with oil pan 38 at the bottom of engine 2 close to main part 11a, it becomes possible to arrange the engine 2 in engine compartment 6 in a compact manner.

5 Since oil tank 40 is arranged in front of cylinder head 3 of engine 2, on the upper surface of front suspension housing 11b, which is projected into engine compartment 6, it is possible to provide a space saving engine arrangement by making the best use of the front space of engine 2. Further, this arrangement makes it possible to receive little thermal
10 influence from the engine and cool the engine oil effectively from the air flow during travel.

[0027]

Further, since opening port 50 for maintenance is formed at a position opposing oil pan 38 of engine compartment bottom
15 6a so as to allow maintenance work such as changing oil etc., to be performed outside engine compartment 6, the maintenance performance can be markedly improved.

Moreover, provision of opening port 50 in an openable and closable configuration has the advantage of not affecting
20 the travel performance of the snowmobile.

[0028]

Though in the present embodiment engine 2 is arranged inclined forwards inside engine compartment 6, the present invention should not be limited to this. For example, as a
25 variational example 1, an engine 102 may be mounted

substantially upright in engine compartment 6 as shown in FIG. 2 with an oil tank 141 arranged on the top surface of front suspension housing 11b located in front of the engine. It is understood that this arrangement is a simple extension of the present invention.

[0029]

Further, in the present embodiment, oil tank 40 is arranged on the top surface of front suspension housing 11b in front of engine 2. However, the present invention should not be limited to this. For example, an oil tank 140 may be arranged on the top face of track housing 11c behind engine 2 as is indicated by a two-dot chain line in FIGS. 1 and 2. In this case, it is possible to provide a space saving arrangement by making effective use of the space over track housing 11c behind engine 2. Further, since the oil tank is located apart from the heat source of the engine and can be cooled by snow powder stirred up during travel, the engine oil can be cooled efficiently.

[0030]

Though, in this embodiment, pivotable lid element 51 is provided so as to open and close the opening port 50 formed at engine compartment bottom 6a, the present invention should not be limited to this. For example, as variational example 2 as shown in FIGS. 3 and 4 a lid element 151 having an approximately congruent shape with an opening port 150 formed

at the engine compartment bottom 6a can be provided separately, and this lid element 151 may be fitted to the opening port 150 and integrally fixed to engine compartment bottom 6a with fasteners 152 such as fastening bolts or the like. In the drawing, reference numeral 153 denotes a threaded hole to secure screw fastener 152.

In this case, opening port 150 may be protrudedly formed into the engine compartment 6 by a height approximately equal to the thickness of lid element 151. This makes it possible to arrange the lid element 151 substantially flush with the engine compartment bottom 6a, providing a refined appearance as well as reducing air drag during travel.

[0031]

As variational example 3, as shown in FIGS. 5 and 6, an opening port 250 with its inner periphery formed with a thread 250a may be formed on engine compartment bottom 6a so as to be projected into engine compartment 6 while a lid element 251 with a thread 251a, mating the thread 250a, formed on its outer periphery may be provided separately. In this case, since no other fastener is needed when lid element 251 is attached to opening port 250, it is possible to improve work performance as well as to use fewer components so reduce the cost.

[0032]

[Effect of the Invention]

As has been described heretofore, according to the snowmobile four-cycle engine arrangements according to Claims 1 to 4 of the present invention, since the oil tank is arranged in the engine compartment, separately from the engine, it is possible to make the use of a four-cycle engine feasible as well as realizing space saving by making efficient use of the space inside the engine compartment.

Further, since the maintenance opening is formed at the bottom of the engine compartment so as to be opened and closed, this is markedly effective in improving the workability of maintenance in changing oil, etc.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1]

FIG. 1 is a partially sectional side view showing an overall configuration of a snowmobile employing a snowmobile four-cycle engine arrangement in accordance with the embodiment of the present invention.

[FIG. 2]

FIG. 2 is a partially sectional plan view showing an overall configuration of a snowmobile of variational example 1 of the present embodiment.

[FIG. 3]

FIG. 3 is a sectional side view showing the arrangement of an engine compartment bottom of variational example 2 of the present embodiment.

[FIG. 4]

FIG. 4 is a bottom-side view showing the arrangement of the engine compartment bottom.

[FIG. 5]

5 FIG. 5 is a sectional side view showing the arrangement of the engine compartment bottom of variational example 3 of the present embodiment.

[FIG. 6]

10 FIG. 6 is a bottom-side view showing the arrangement of the engine compartment bottom.

[FIG. 7]

FIG. 7 is a partially sectional side view showing an overall configuration of a snowmobile having a conventional four-cycle engine mounted thereon.

15 [DESCRIPTION OF REFERENCE NUMERALS]

1 snowmobile

2, 102 engine

6 engine compartment

6a engine compartment bottom

20 11 front frame

11a main part

11c track housing

11b front suspension housing

38, 138 oil pan

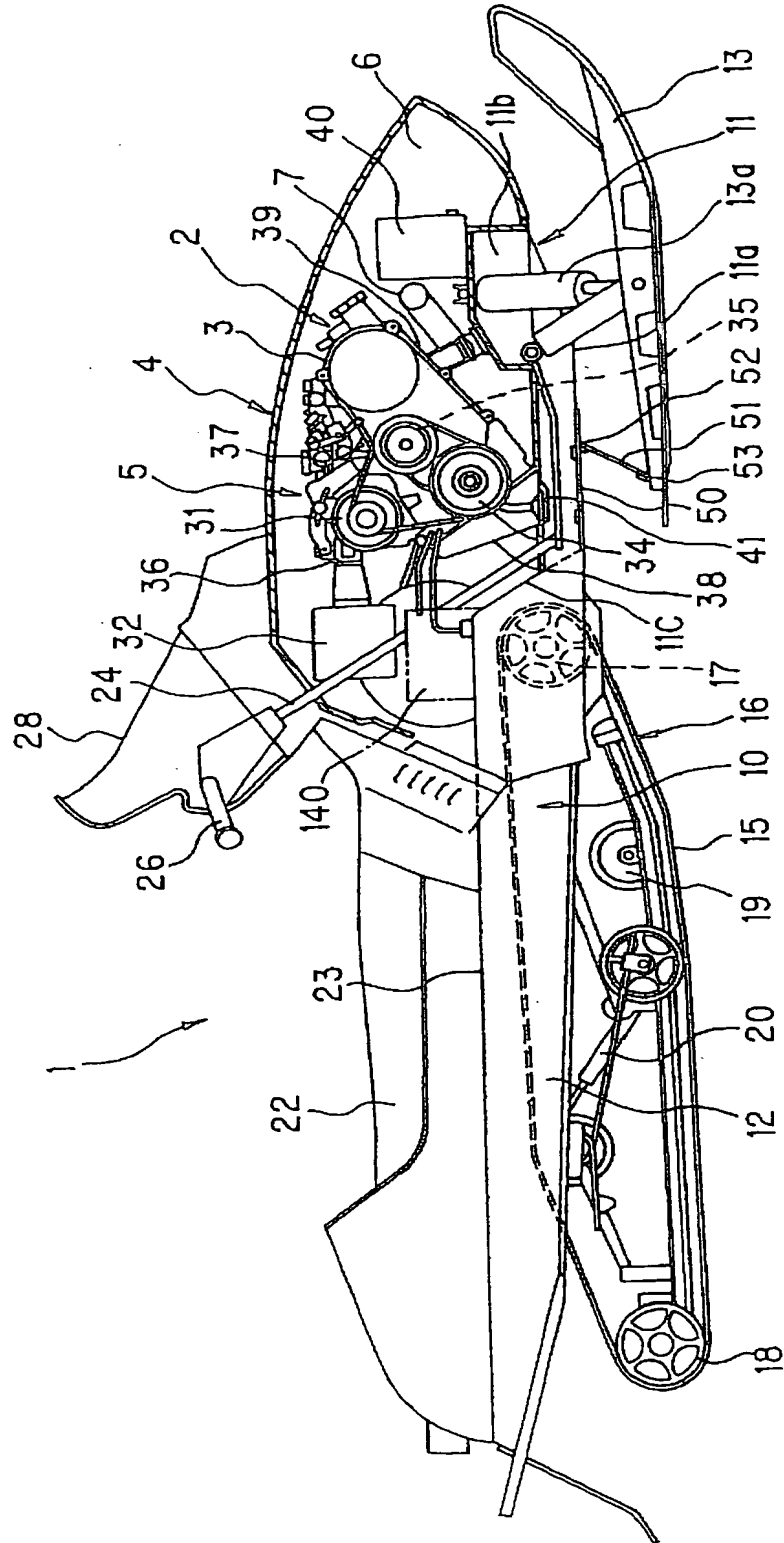
25 40, 140, 141 oil tank

50, 150, 250 opening port

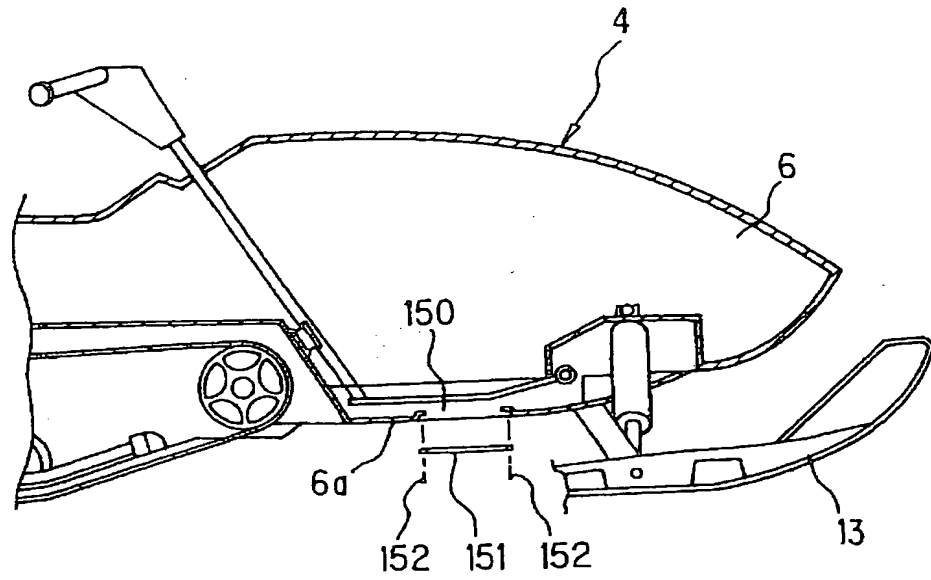
51, 151, 251 lid element

[NAME OF DOCUMENT] DRAWINGS

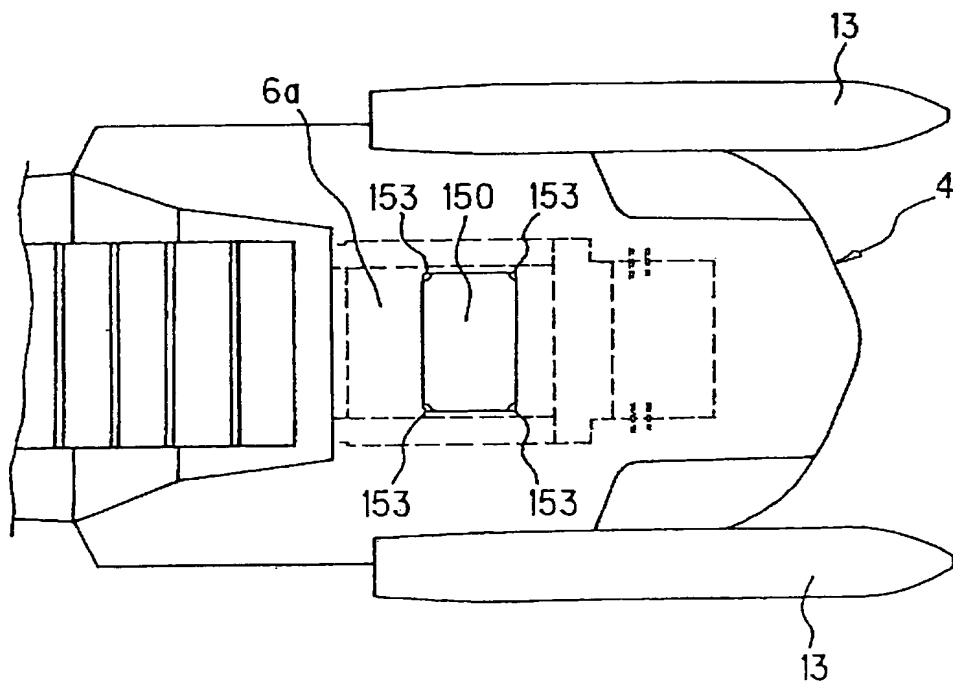
[FIG. 1]



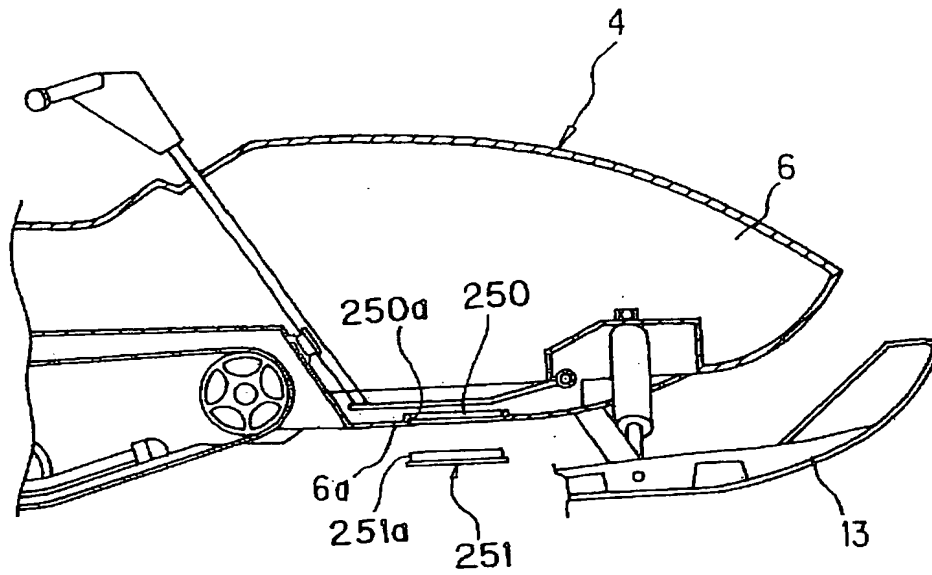
[FIG. 3]



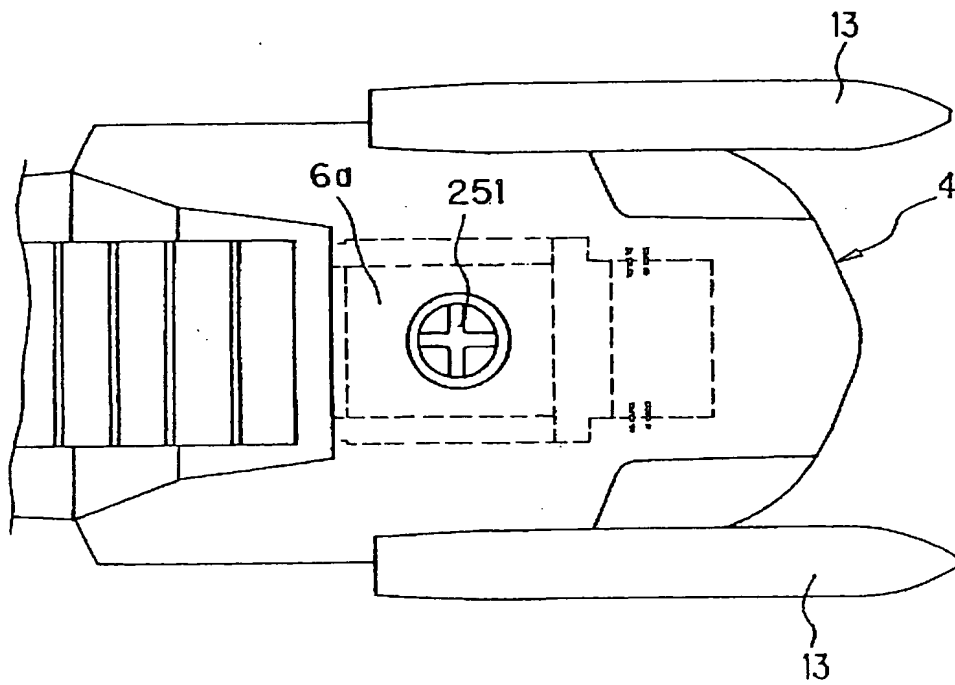
[FIG. 4]



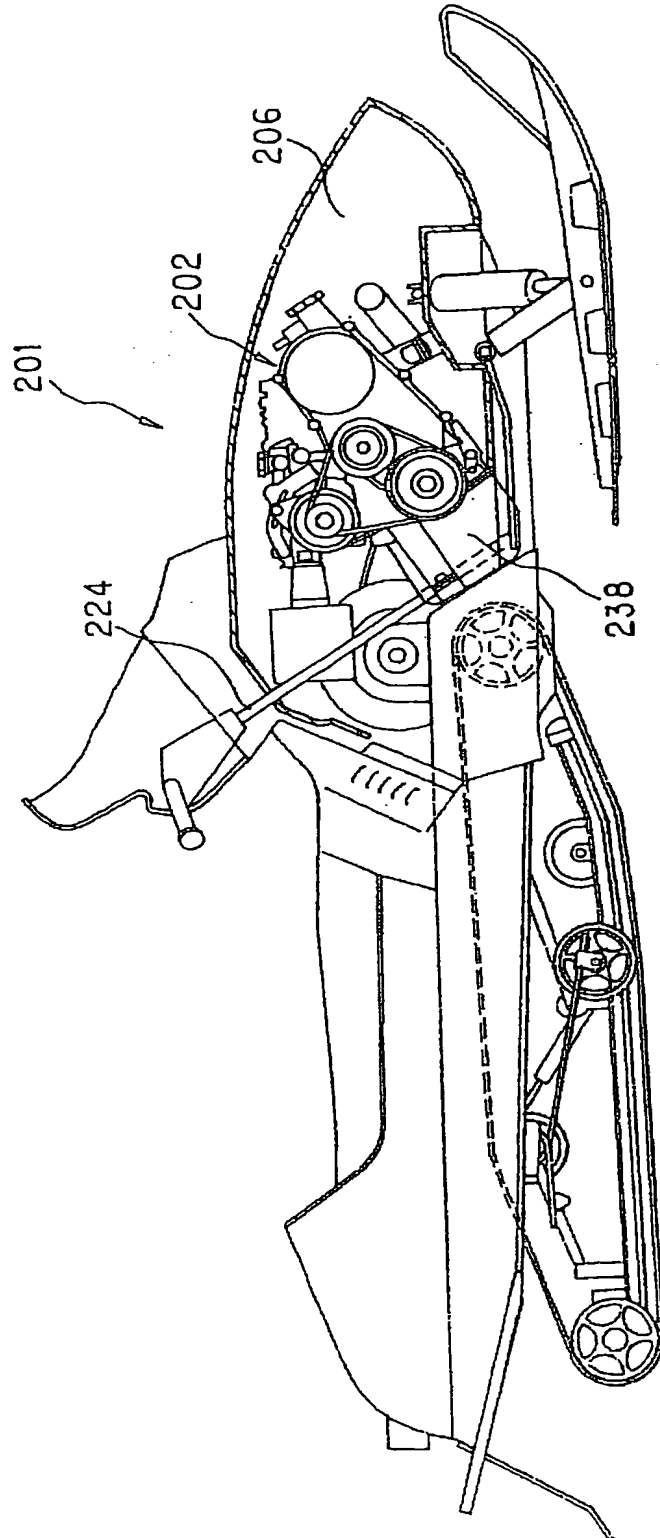
[FIG. 5]



[FIG. 6]



[FIG. 7]



[NAME OF DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT]

5 The object is to provide a snowmobile four-cycle engine arrangement with which space saving in the engine compartment is achieved and the performance of maintenance is improved.

[MEANS FOR SOLUTION]

10 A snowmobile four-cycle engine arrangement is constructed such that a snowmobile four-cycle engine 2 is arranged in an engine compartment 6 formed in the front body of a snowmobile 1 with its crankshaft laid substantially parallel to the body width and having a cylinder case 39 inclined forwards with respect to the vehicle's direction of travel; the engine 2 employs a dry sump type for oil supplying system
15 in the engine; and an oil tank 40 is provided in engine compartment 6, separately from the engine.

[SELECTED DRAWING] FIG. 1

1
Japanese Patent Application No. 2000-270363

Information of Applicant Data

Identification No. [000002082]

1. Change Date April 27, 1991

[Reason of Change] Change of address

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